REMARKS

Claims 6–10, 16–20, and 22–24 are pending in the application. Claims 1–5, 11–15 and 21 were previously canceled. Independent claims 6, 16, 22, and 23 have been amended by this amendment.

The key to the disclosed and claimed invention lies in the structure of the 8-bit electronic watermark information illustrated in Figure 10 of the drawings, and as described in the paragraph bridging pages 5 and 6 of the specification. As illustrated and described, the high-order four bits of an 8-bit watermark contains information defined by the electronic watermark promotion organization, mentioned on page 6 of the specification. The electronic watermark organization is DVD Copy Protection Technical Working Group (DVD CPTWG) as described in Appendix I, attached to this amendment. Appendix I was taken from the IBM Web site whose URL address is http://www.research.ibm.com/trl/projects/RightsManagement/datahiding/dhvgx_e.htm. The DVD CPTWG issued a Call for Proposals for a suitable standard and the Galaxy group including NEC, the assignee of this application, made proposal in 1999. The proposed standard is described in Appendix II, attached to this amendment. Appendix II was also taken from the IBM Web site http://www.research.ibm.com/trl/projects/RightsManagement/datahiding/dhvg2_e.htm. Appendix III, attached to this amendment, is a paper published March 2, 1999, entitled "Galaxy Watermark Technology for DVD Copy Protection" which names Hitachi, IBM, NEC, Pioneer and Sony as members of the Galaxy group and provides further description of the proposed standard. The present invention is based on this proposed standard. More particularly, the disclosed and claimed invention makes use of the undefined bit-data in the electronic watermark information for performing a function (i.e., executing an instruction) other than copy protection.

Claim 6, as amended, recites "A device that detects an electronic watermark from a compressed original image, *which electronic watermark includes information consisting of first bits defined as CCI (copy protection) bits, second bits defined as reserved and third bits as undefined bit-data*" (emphasis added). This device includes, *inter alia*, "a circuit which detects electronic

watermark data embedded in data for which IDCT has been performed *along with the value of said bit-data for which is defined a plurality of instructions*", "*a table file including one of said instructions for said value of said bit-data*", and "*a circuit which performs a processing according to said instruction in said table file*" (emphasis added). In other words, claim 6 makes quite clear that what is being done within the copy protection scheme is quite unrelated to the function of copy protection. Rather, the undefined bits are being used to contain bit-data, the value of which is used to access a table of instructions. The instruction identified by the value of the bit-data is then executed. The executed instruction could be for any purpose. This allows the watermark to be used not only for copy protection but also for many other purposes.

Claim 16 recites "A method for detecting an electronic watermark from a compressed original image, *which electronic watermark includes information consisting of first bits defined as CCI (copy protection) bits, second bits defined as reserved and third bits as undefined bit-data*" (emphasis added). This method includes, *inter alia*, the steps of "performing inverse discrete cosine transform (IDCT) for said decoded data obtained from said decoding step", "detecting electronic watermark data embedded in data for which IDCT has been performed, *along with the value of said bit-data for which is defined a plurality of instructions*",and "*performing processing according to an instruction obtained from a table file including a plurality of instructions corresponding to values of said bit-data and which includes an instruction for said value of said bit-data*" (emphasis added). Claim 22 recites "A computer-readable recording medium storing therein a program for detecting an electronic watermark embedded in an original image, *which electronic watermark includes information consisting of first bits defined as CCI (copy protection) bits, second bits defined as reserved and third bits as undefined bit-data*" (emphasis added). The program causes the computer to "read a compressed image data and a table data, *said table data defining a plurality of instructions corresponding to said bit-data included in said electronic watermark*" (emphasis added). The program further causes the computer to "*perform processing according to one of said instructions in said table corresponding to said bit-data included in said electronic watermark*"

(emphasis added). Claim 23 recites "A device that detects an electronic watermark from an original image, *which electronic watermark includes information consisting of first bits defined as CCI (copy protection) bits, second bits defined as reserved and third bits as undefined bit-data from an original image*" (emphasis added). This device includes, *inter alia*, "a circuit which detects said electronic watermark from said original image data *along with the value of said bit-data for which is defined one of a plurality of instructions*", "*a table file including said plurality of said instructions corresponding to values of said bit-data*", and "*a circuit which performs processing according to one of said instructions in said table file corresponding to the value of said bit-data contained in said original image*" (emphasis added).

The Examiner had previously rejected claims 6–10, 16–20 and 22–24 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,310,962 to Chung et al. in view of U.S. Patent No. 6,374,036 to Ryan et al. This rejection is respectfully traversed for the reason that the combination of Chung et al. and Ryan et al. do not show, teach or otherwise suggest the claimed invention.

Both the patents to Chung et al. and Ryan et al. are specifically directed to copy protection based on the electronic water mark. Neither of the references, mentions or proposes any user for the undefined bit-data upon which the claimed invention is based. The claimed invention makes use of the undefined bit-data in the electronic watermark information of a proposed standard for performing a function (i.e., executing an instruction) <u>other</u> than copy protection. There is no suggestion in the prior art of the claimed invention.

In view of the foregoing, it is respectfully requested that the application be reconsidered, that claims 6–10, 16–20 and 22–24 be allowed, and that the application be passed to issue.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

A provisional petition is hereby made for any extension of time necessary for the continued pendency during the life of this application. Please charge any fees for such provisional petition and any deficiencies in fees and credit any overpayment of fees to Attorney's Deposit Account No. 50-2041.

Respectfully submitted,

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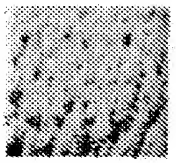
Watermark Standardization for DVD Copy Protection / Galaxy



* This research project has been completed.

On February 17, IBM, NEC, Pioneer, Hitachi, and Sony announced the formation of the "Galaxy" group to merge watermarking proposals for DVD copy protection, and on March 2 they submitted a unified proposal on video watermarking to the DVD Watermark Review Panel (WaRP). IBM's Tokyo Research Laboratory technology was selected as a core technology of the Galaxy group's proposal.

- Galaxy Proposal
- DataHiding Technology for Video

Background story of DVD copy protection

A DVD is a 4.7-gigabyte removable storage medium, and can accommodate two and a half hours of MPEG-2 encoded motion picture data. Hollywood expects that DVD will expand the home video market on account of its clear visual quality, just as CD audio spurred a remarkable growth in recorded music sales from 1988 to 1995. But they are also afraid that the prevalence of casual piracy may destroy the potential DVD market, since MP3 and the Internet are generating casual CD audio piracy and harming the recorded music market. (See background story on the music recording industry.) In 1996, the Motion Picture Association of America (MPAA), the Recording Industry Association of America (RIAA), consumer electronics manufacturers, and information technology companies formed the DVD Copy Protection Technical Working Group (CPTWG) to protect the new business opportunity in the DVD home video market from casual piracy. The DVD CPTWG began by launching an encryption approach called Content Scrambling System (CSS) in 1997. However, no encryption approach can prevent illegal copying through the analog output of a DVD player or stop circulation of unauthorized copies from person to person. Thus, CSS is not sufficient for protection against casual piracy.

IBM was the first proposer of copy and playback control by watermarking

Watermarks survive digital-analog conversion. In September 1996, IBM's Tokyo Research Laboratory (TRL) first proposed the use of watermarking technology for DVD copy protection at the DVD CPTWG, and showed that the TRL technology can detect embedded watermarks in both uncompressed and MPEG-2-compressed domains. This led to the development of a new framework in which DVD recording and playing devices automatically prevent unauthorized recording and playback of unauthorized copies by means of Copy Control Information (CCI) detected in digital video content. The new framework contains direct and aggressive measures to promote copy protection, but does not violate the privacy of consumers, unlike the conventional digital watermark framework, which was based on a "monitoring" and "tracking" approach whereby a system is assumed to embed a consumer's personal information invisibly in digital content for tracking purposes.

DataHiding Application Framework

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Data Hiding Sub-Group (DHSG) formed under DVD CPTWG

The new framework, which controls recording and playback by means of watermarks, requires the standardization of watermarking for effective implementation in consumer DVD devices. In May 1997 the Data Hiding Sub-Group (DHSG) was formed under the DVD CPTWG, and issued a Call for Proposals (CFP). The CFP defined a set of requirements, ranked as either essential or desirable. The essential requirements are as follows:

Call for Proposals issued by the DHSG in July 1997

- Transparency
- Low-cost digital detection
- Digital detection domain: The digital detection can be done in the source data (uncompressed digital video), MPEG-2 compressed elementary data, a multiplexed stream (program/transport), and/or logical sector data.
- Generational copy control for one copy
- Low false positive detection rate: no error lasting 10 seconds in 400 hours of operation.
  (Consumer electronics manufacturers now claim no error in "316,890 years" instead of no error in "400 hours.")
- Reliable detection
- Ability of watermark to survive normal video processing in consumer use.
- Licensable under reasonable terms
- No restrictions on export/import
- Technical maturity
- Data payload; three states (Never copy, No More Copying, and Copy Once) and an additional 2 bits for APS at a minimum.
  (the DVD CPTWG agrees to 8 bits of data payload)
- Minimum impact on content preparation
- Data Rate: at least 11.08 Mb/s

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Eleven Proposals Reduced to Two in February 1999

The eleven proposals submitted in response to the CFP were subjected to the visual and survivability tests using common sample clips, in October 1997 and February 1998, respectively. In May 1998 the DHSG issued an interim report entitled "Results of Phases I and II" and IBM's proposal had the best survivability in the DHSG test. This report led the merging of the original eleven watermarking proposals into three by July 1998: an IBM-NEC proposal, a Pioneer-Hitachi-Sony proposal, and a Macrovision-Digimarc-Philips proposal. The watermarking technology of IBM's Tokyo Research Laboratory was adapted as the core of the IBM-NEC proposal. Consumer electronics companies such as Pioneer, Hitachi, and Sony have a strong interest in the transparency of watermarking. Beginning at the end of 1998, the IBM-NEC group and the Pioneer-Hitachi-Sony group held a sequence of meetings to evaluate the proposals technically. As a result, Pioneer, Hitachi, and Sony admitted that the IBM-NEC watermarking technology offers an acceptable level of transparency by allowing automatic visual control of the embedding processor. Thus, in February 1999, IBM, NEC, Pioneer, Hitachi, and Sony announced the Galaxy team for standardization of watermarking for DVD copy protection.

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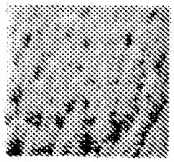
Galaxy Proposal for DVD Copy Protection



* This research project has been completed.

Galaxy Watermark Proposal March 2, 1999

We propose the Galaxy watermarking technology and system, comprising a Primary Mark and a Copy Mark, for preventing unauthorized recording and playback of copyrighted video content on consumer devices and PCs. While the main focus of the proposed system is DVD, it may also be applicable to satellite, cable, and other means for electronic distribution of video content. The system offers playback control, recording control, and generational copy control according to four copy protection states - "Copy Freely," "Copy Once," "No More Copying" and "Never Copy" - which are specified by the Primary Mark and Copy Mark in the video content.

A **Primary Mark** is an 8-bit transparent digital watermark that is embedded in digital video data. The Galaxy technology allows a compliant device to detect a Primary Mark in both the baseband (uncompressed) and MPEG-2 compressed domains. The first two bits of a Primary Mark are Copy Control Information (CCI) and represent "Copy Freely," "Copy Once," and "Never Copy" in the case where there is no Copy Mark. The next two bits are APS trigger bits. The remaining four bits are reserved for the use of the content owner.

A **Copy Mark** is another transparent digital watermark, which does not interfere with a Primary Mark. The Galaxy technology allows a compliant device to insert and detect a Copy Mark in both the baseband and MPEG-2 domains. A DVD recorder inserts it into "Copy Once" content to change the status to "No More Copying" for the purpose of generational copy control.

Record Copy and Generational Copy Control:
A detector sends a signal to the recording controller to stop or insert noise when it detects "Never Copy" or "Copy Once" with a Copy Mark.

Playback Control:
A detector sends a signal to the playback controller to stop or insert noise when it detects "Never Copy" or "Copy Once" with a Copy Mark in recordable/rewritable media.

The Galaxy technology offers highly transparent and secure Primary Marks and Copy Marks. They survive digital-analog conversion, MPEG-2 coding/encoding, and various types of signal processing. The Galaxy detector uses the adaptive period detection algorithm to detect Primary Marks with a predetermined false positive error ratio. Even in heavily degraded contents, reliable detection can be achieved without exceeding the predetermined false positive ratio, which is set to less than 10^{-12} for ten seconds, through a trade off that involves extending the detection time window. Primary Marks survive successive processes of studio video processing, MPEG-2 compression, VHS recording, and MPEG-2 recompression. The applied studio video processes include brick wall filtering, aperture enhancement, noise reduction, 98% speed reduction, 50% watermark

blending, letterbox conversion, offset letterbox conversion, random spatial shifting, and hue shifting.

- Background Story of DVD Copy Protection
- DataHiding Technology for Video
- Science and Technology of DataHiding

DataHiding Home Page

Last modified 16 Feb 2001

Appendix III

Galaxy Watermark Technology for DVD Copy Protection

March 2, 1999

Hitachi Ltd., IBM Corporation, NEC Corporation
Pioneer Electronic Corporation, Sony Corporation

Outline

System architecture
Copy-Once function
Technical maturity
Gate Count Analysis
Survivability tests
False positive analysis
Watermark Embedding Technology

Watermark Features

Unified primary watermark
- -High visual quality with automated image quality adjustment
- -High survivability with unified watermark design

Adaptive frame accumulation
- -Adaptive detection period adjustment for constant detection reliability
- -Attenuated video segment is compensated by detection time
- -Offer freedom for the contents owners to adjust the watermark strength

Copy Mark Insertion for One-Copy Application
- -Insertion into MPEG2 bit stream and into baseband to offer design freedom
- -Preserve MPEG packet size for on-the-fly insertion

Translational Search Capability
- -Translational search with high computation efficiency
- -Provide robustness against random spatial shift of picture

Security Features
- -Prevent hacking by analyzing video (frame averaging, subtraction etc.)
- -Detector logic does not contain sufficient information for watermark removal

Future Upgradability including HD

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(1) System Architecture

Playback Control
Record Control and Copy-Once function

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Basic Concept

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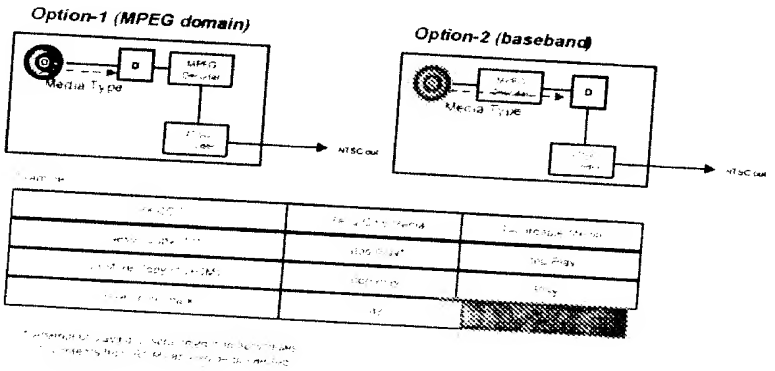
DVDWG Document 99/CFCR02-2

Playback Control in DVD Playback Device



Watermark can be detected in MPEG domain & baseband

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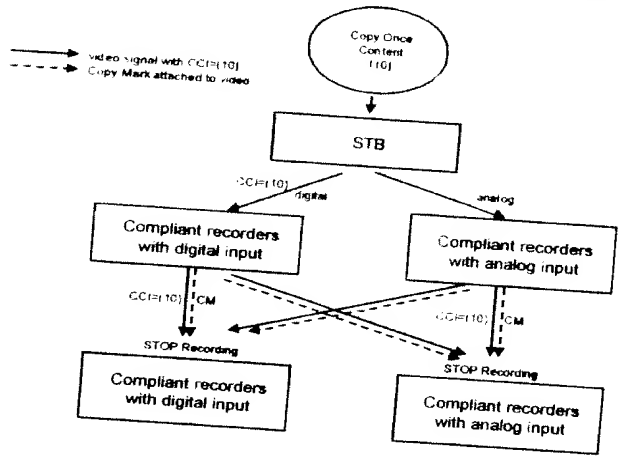
(2) Copy Mark (CM) Insertion for One Copy



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Copy Mark Insertion Technology

Fully satisfy system requirement
- -Support One Copy Function including analog transmission
- -No cooperative action required to the existing devices in the transmission paths
- -Does not obsolete install base products in the market

Feasible for MPEG domain direct insertion
- -Preserve MPEG packet size and file structure
- -Offer great design freedom for the detector location

Fully Interchangeable between MPEG and baseband domain
- -Same Copy Mark can be embedded in MPEG and baseband domain
- -Same watermark is detectable in both MPEG and baseband domain

Security consideration
- -Design to be orthogonal to the Primary watermark (CCI)
- -Design to be independent from the Primary watermark (CCI)

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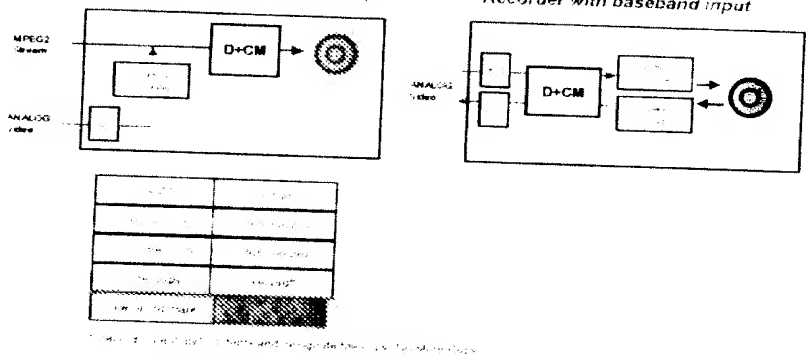
Record Control in DVD Recordable Devices

Recorder with MPEG and baseband input

Recorder with baseband input



Watermark detection and Copy Mark insertion can be done in MPEG & baseband domain

(3) Technical Maturity

GALAXY Watermark Function Description

DVDWG Document 99/CFCR02-2

Galaxy Watermark Function

Automated Watermark Embedding System
- -Automated optimizing process
  - Image quality adjustment
  - Optimize embedding strength
- -Pixel by pixel adjustment capability

Watermark Detection and Copy Mark insertion Logic
- -Watermark detection from MPEG2 bit stream
- -Watermark detection from baseband
- -Copy Mark insertion into MPEG2 bit stream
- -Copy Mark insertion into baseband

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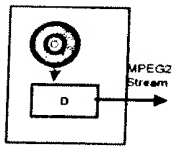
DVDWG Document 99/CFCR02-2

Watermark Detection Implementation Examples

Logic-1
(MPEG domain)
Playback Control

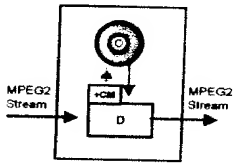
DVD-Drive/Player



- Primary watermark detection
- Copy Mark detection

Logic-2
(MPEG domain)
Playback Control
Record Control including
Copy Mark insertion

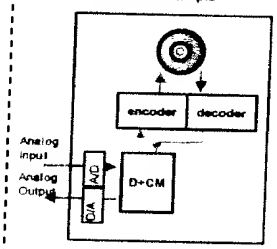
DVD-Rrcordable devicesr



- Primary watermark detection
- Copy Mark detection
- Copy Mark insertion

Logic-3
(Baseband domain)
Playback Control
Record Control including
Copy Mark insertion

Standalone Digital
Recorder Example



- Primary watermark detection
- Copy Mark detection
- Copy Mark insertion

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(4) Gate Count Estimation

Logic Type	Purpose	Functional Description	Gate Counts	Target Devices
1	Playback control	Primary Mark and Copy Mark watermark detection from MPEG stream.	30 k Gates 5 kbyte RAM	DVD playback device
2	Playback control Record control Generation Copy Control	Primary Mark and Copy Mark watermark detection and Copy Mark insertion in MPEG stream.	50k Gates 5 kbyte RAM	DVD recordable Drive DVD Recorder
3	Playback control Record control Generation Copy Control	Primary Mark and Copy Mark watermark detection and Copy Mark insertion in baseband domain after A/D conversion.	50 k Gates 7 kbyteRAM	DVD recordable devices with analog video input

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(5) Survivability Tests

Survivability tests
Consumer environment tests

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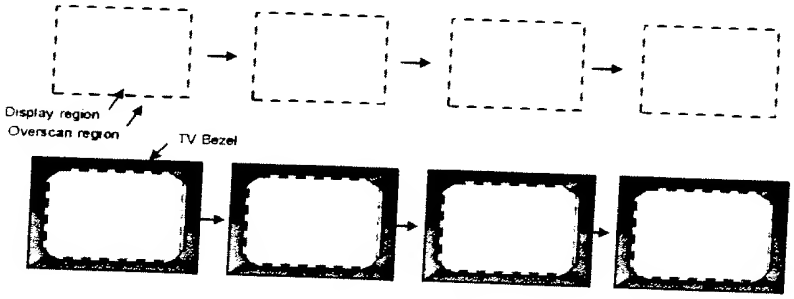
Survivability Verification Test

- Successfully survives all DHSG equivalent test items
  - DVNR, 2-D adaptive noise reduction (frame/field)
  - Aperture enhancement (frame/field)
  - Letterbox conversion (frame/field)
  - Offset letterbox conversion (frame/field)
  - Speed reduction (98%)
  - Mark blending (50%, 75%)
- Successfully survives following consumer domain tests
  - MPEG compression (4Mbps, CBR) + MPEG re-compression
  - MPEG compression + VHS recording + MPEG re-compression
  - Random picture shifting
  - Hue-shifting (30 degree hue shifting)*
- Successfully survives following real broadcasting channel
  - Analog cable transmission*
- HD down conversion survivability was successfully tested

Random Picture Shifting Test

Picture shifting is one of the most simple and cheap attack which capable to disable many existing watermark technologies.



GALAXY Watermark survives random picture shifting attack.
-> DEMONSTRATION AVAILABLE

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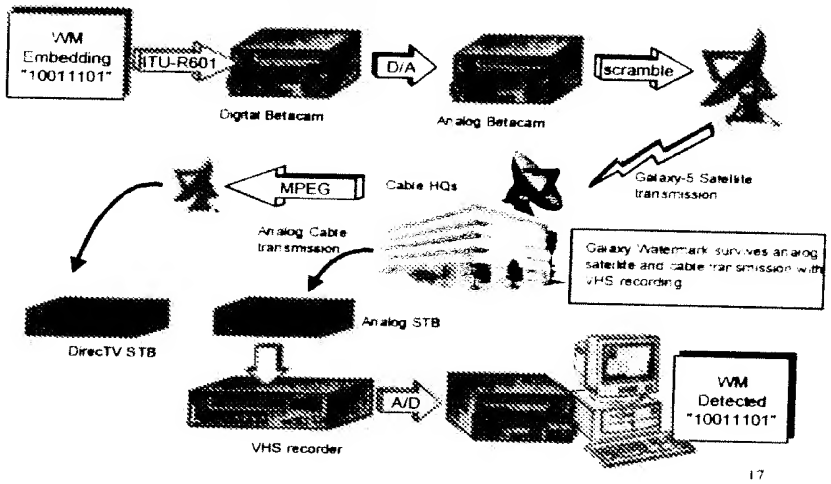
Analog Cable/DirecTV Transmission Test



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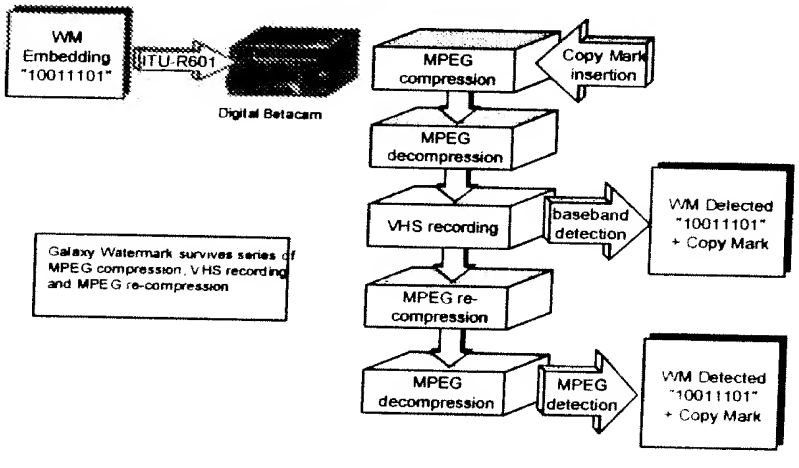
Survivability of Primary and Copy Mark through MPEG re-compression with VHS recording



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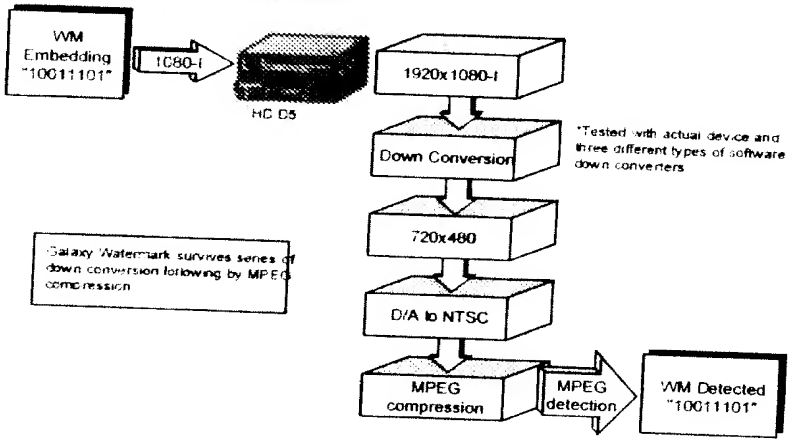
HDTV down conversion survivability



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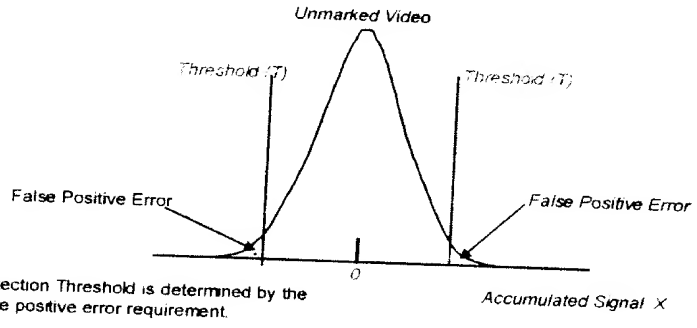
(6) False Positive Analysis

-Probability density function of detection signal distribution from unmarked video is a normal distribution
-Detection value from each bit is independent from each other
-Decision is made by the bit with least signal strength



Detection Threshold is determined by the false positive error requirement.

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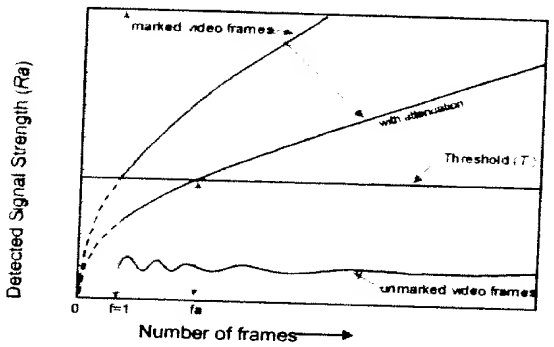
Adaptive Frame Accumulation



Ra : accumulated detected signal strength, T : threshold for frame accumulation

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Threshold vs. False Positive Ratio

Target ratio (e) of false positive errors	Threshold (T) for 8-bit detection
10-8	1.85878
10-9	1.98372
10-10	2.10306
10-11	2.21752
10-12	2.32729
10-13	2.44118

- Theoretical analysis based on 8-bit detection
- False positive error per detection period (10 sec.)

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(7) Watermark Embedding Technology

Automated Image Quality Adjustment
- -High visual quality adjusted pixel by pixel
- -High reliability achieved by maximizing the embedding signal

Great freedom of the watermark embedding process
- -Embedding system has CCIR601 input and output
- -Embedding system can be placed anywhere in the video production process

Same watermark can be detected in MPEG and baseband
- -Equivalent detection reliability and mathematical model
- -Sharing single common detection logic

Primary watermark is orthogonal to the Copy Mark
- -No disturbance or conflict between Primary watermark and Copy Mark
- -Independence from the Copy Mark provide security barrier for Primary watermark

Watermark is designed to embed arbitrary 8-bit information
- -Common test condition defined by DHSG
- -First four bits were defined for CCI (CGMS and APS)

Real-time Studio Embedding System
- -D1 input and output with few frame delay
- -PC based system with DSP